Claims

1. A mass spectrometer comprising:

a mass filter for separating ions according to their mass to charge ratio, said mass filter comprising at least seven electrodes wherein, in use, an AC or RF voltage is applied to said electrodes in order to radially confine ions within said mass filter and wherein in use one or more transient DC voltages or one or more transient DC voltage waveforms are progressively applied to said electrodes so that at least some ions having a first mass to charge ratio are separated from other ions having a second different mass to charge ratio which remain substantially radially confined within said mass filter.

2. A mass spectrometer as claimed in claim 1, wherein said mass filter is maintained, in use, at a pressure selected from the group consisting of: (i) greater than or equal to $1x10^{-7}$ mbar; (ii) greater than or equal to $5x10^{-7}$ mbar; (iii) greater than or equal to $1x10^{-6}$ mbar; (iv) greater than or equal to $5x10^{-6}$ mbar; (v) greater than or equal to $1x10^{-5}$ mbar; and (vi) greater than or equal to $5x10^{-5}$ mbar.

3. A mass spectrometer as claimed in claim 1, wherein said mass filter is maintained, in use, at a pressure selected from the group consisting of: (i) less than or equal to $1x10^{-4}$ mbar; (ii) less than or equal to $5x10^{-5}$ mbar; (iii) less than or equal to $1x10^{-5}$ mbar; (iv) less than or equal to $5x10^{-6}$ mbar; (v) less than or equal to $1x10^{-6}$ mbar; (vi) less than or equal to $5x10^{-7}$ mbar; and (vii) less than or equal to $1x10^{-7}$ mbar.

4. A mass spectrometer as claimed in claim 1, wherein said mass filter is maintained, in use, at a pressure selected from the group consisting of: (i) between $1x10^{-7}$ and $1x10^{-4}$ mbar; (ii) between $1x10^{-7}$ and $5x10^{-5}$ mbar; (iii) between $1x10^{-7}$ and $1x10^{-5}$ mbar; (iv) between $1x10^{-7}$ and $5x10^{-6}$ mbar; (v) between $1x10^{-7}$ and $1x10^{-6}$ mbar; (vi) between $1x10^{-7}$ and $5x10^{-7}$ mbar; (vii) between $5x10^{-7}$ and $1x10^{-4}$ mbar; (viii) between $5x10^{-7}$ and $5x10^{-5}$ mbar; (ix) between $5x10^{-7}$ and $1x10^{-5}$ mbar; (x) between $5x10^{-7}$ and $5x10^{-6}$ mbar; (xi) between $5x10^{-7}$ and $1x10^{-6}$ mbar; (xii) between $1x10^{-6}$ mbar and $1x10^{-4}$ mbar; (xiii) between $1x10^{-6}$ and $5x10^{-5}$ mbar; (xiv) between $1x10^{-6}$ and $1x10^{-5}$ mbar; (xv) between $1x10^{-6}$ and $5x10^{-6}$ mbar; (xvi) between $5x10^{-6}$ mbar and $1x10^{-4}$ mbar; (xvii) between $5x10^{-6}$ and $5x10^{-5}$ mbar; (xviii) between $5x10^{-6}$ and $1x10^{-5}$ mbar; (xix) between $1x10^{-5}$ mbar and $1x10^{-4}$ mbar; (xx) between $1x10^{-5}$ and $5x10^{-5}$ mbar; and (xxi) between $5x10^{-5}$ and $1x10^{-4}$ mbar.

5. A mass spectrometer as claimed in claim 1, wherein said one or more transient DC voltages or one or more transient DC voltage waveforms is such that at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% or 95% of said ions having said first mass to charge ratio are substantially moved along said mass filter by said one or more transient DC voltages or said one or more transient DC voltage waveforms as said one or more transient DC voltages or said one or more transient DC voltage waveforms are progressively applied to said electrodes.

6. A mass spectrometer as claimed in claim 1, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms are such that at

least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% or 95% of said ions having said second mass to charge ratio are moved along said mass filter by said applied DC voltage to a lesser degree than said ions having said first mass to charge ratio as said one or more transient DC voltages or said one or more transient DC voltage waveforms are progressively applied to said electrodes.

7. A mass spectrometer as claimed in claim 1, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms are such that at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% or 95% of said ions having said first mass to charge ratio are moved along said mass filter with a higher velocity than said ions having said second mass to charge ratio.

8. A mass spectrometer comprising:

an mass filter for separating ions according to their mass to charge ratio, said mass filter comprising at least seven electrodes wherein, in use, an AC or RF voltage is applied to said electrodes in order to radially confine ions within said mass filter and wherein in use one or more transient DC voltages or one or more transient DC voltage waveforms are progressively applied to said electrodes so that ions are moved towards a region of the mass filter wherein at least one electrode has a potential such that at least some ions having a first mass to charge ratio will pass across said potential whereas other ions having a second different mass to charge ratio will not pass across said potential but will remain substantially radially confined within said mass filter.

9. A mass spectrometer as claimed in claim 8, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms are such that at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% or 95% of said ions having said first mass to charge ratio pass across said potential.

10. A mass spectrometer as claimed in claim 8, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms are such that at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% or 95% of said ions having said second mass to charge ratio will not pass across said potential.

11. A mass spectrometer as claimed in claim 8, wherein said at least one electrode is provided with a voltage such that a potential hill or valley is provided.

12. A mass spectrometer as claimed in claim 8, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms are such that at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% or 95% of said ions having said first mass to charge ratio exit said mass filter substantially before ions having said second mass to charge ratio.

13. A mass spectrometer as claimed in claim 8, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms are such that at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% or 95% of said ions having said second mass to charge ratio exit said mass filter substantially after ions having said first mass to charge ratio.

14. A mass spectrometer as claimed in claim 8, wherein a majority of said ions having said first mass to charge ratio exit said mass filter a time t before a majority of said ions having said second mass to charge ratio exit said mass filter, wherein t falls within a range selected from the group consisting of: (i) < 1 μs; (ii) 1-10 μs; (iii) 10-50 μs; (iv) 50-100 μs; (v) 100-200 μs; (vi) 200-300 μs; (vii) 300-400 μs; (viii) 400-500 μs; (ix) 500-600 μs; (x) 600-700 μs; (xi) 700-800 μs; (xii) 800-900 μs; (xiii) 900-1000 μs.

15. A mass spectrometer as claimed in claim 8, wherein a majority of said ions having said first mass to charge ratio exit said mass filter a time t before a majority of said ions having said second mass to charge ratio exit said mass filter, wherein t falls within a range selected from the group consisting of: (i) 1.0-1.5 ms; (ii) 1.5-2.0 ms; (iii) 2.0-2.5 ms; (iv) 2.5-3.0 ms; (v) 3.0-3.5 ms; (vi) 3.5-4.0 ms; (vii) 4.0-4.5 ms; (viii) 4.5-5.0 ms; (ix) 5-10 ms; (x) 10-15 ms; (xi) 15-20 ms; (xii) 20-25 ms; (xiii) 25-30 ms; (xiv) 30-35 ms; (xv) 35-40 ms; (xvi) 40-45 ms; (xvii) 45-50 ms; (xviii) 50-55 ms; (xix) 55-60 ms; (xx) 60-65 ms; (xxi) 65-70 ms; (xxii) 70-75 ms; (xxiii) 75-80 ms; (xxiv) 80-85 ms; (xxv) 85-90 ms; (xxvi) 90-95 ms; (xxvii) 95-100 ms; and (xxviii) > 100 ms.

16. A mass spectrometer comprising:

a mass filter for separating ions according to their mass to charge ratio, said mass filter comprising a plurality of electrodes wherein, in use, an AC or RF voltage is applied to said electrodes in order to radially confine ions within said mass filter and

wherein in use one or more transient DC voltages or one or more transient DC voltage waveforms are progressively applied to said electrodes so that:

(i) ions are moved towards a region of the mass filter wherein at least one electrode has a first potential such that at least some ions having first and second different mass to charge ratios will pass across said first potential whereas other ions having a third different mass to charge ratio will not pass across said first potential; and then

(ii) ions having said first and second mass to charge ratios are moved towards a region of the mass filter wherein at least one electrode has a second potential such that at least some ions having said first mass to charge ratio will pass across said second potential whereas other ions having said second different mass to charge ratio will not pass across said second potential.

17. A mass spectrometer as claimed in claim 16, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms and said first potential are such that at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% or 95% of said ions having said first mass to charge ratio pass across said first potential.

18. A mass spectrometer as claimed in claim 16, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms and said first potential are such that at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% or 95% of said ions having said

second mass to charge ratio pass across said first potential.

19. A mass spectrometer as claimed in claim 16, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms and said first potential are such that at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% or 95% of said ions having said third mass to charge ratio do not pass across said first potential.

20. A mass spectrometer as claimed in claim 16, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms and said second potential are such that at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% or 95% of said ions having said first mass to charge ratio pass across said second potential.

21. A mass spectrometer as claimed in claim 16, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms and said second potential are such that at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% or 95% of said ions having said second mass to charge ratio do not pass across said second potential.

22. A mass spectrometer as claimed in claim 16, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms are such that at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% or 95% of said ions having said second mass to charge ratio

exit said mass filter substantially before ions having said first and third mass to charge ratios.

23. A mass spectrometer as claimed in claim 16, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms are such that at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% or 95% of said ions having said first and third mass to charge ratios exit said mass filter substantially after ions having said second mass to charge ratio.

24. A mass spectrometer as claimed in claim 16, wherein a majority of said ions having said second mass to charge ratio exit said mass filter a time t before a majority of said ions having said first and third mass to charge ratios exit said mass filter, wherein t falls within a range selected from the group consisting of: (i) < 1 μs; (ii) 1-10 μs; (iii) 10-50 μs; (iv) 50-100 μs; (v) 100-200 μs; (vi) 200-300 μs; (vii) 300-400 μs; (viii) 400-500 μs; (ix) 500-600 μs; (x) 600-700 μs; (xi) 700-800 μs; (xii) 800-900 μs; (xiii) 900-1000 μs.

25. A mass spectrometer as claimed in claim 16, wherein a majority of said ions having said second mass to charge ratio exit said mass filter a time t before a majority of said ions having said first and third mass to charge ratios exit said mass filter, wherein t falls within a range selected from the group consisting of: (i) 1.0-1.5 ms; (ii) 1.5-2.0 ms; (iii) 2.0-2.5 ms; (iv) 2.5-3.0 ms; (v) 3.0-3.5 ms; (vi) 3.5-4.0 ms; (vii) 4.0-4.5 ms; (viii) 4.5-5.0 ms; (ix) 5-10 ms; (x) 10-15 ms; (xi) 15-20 ms; (xii) 20-25 ms; (xiii) 25-30 ms; (xiv) 30-35 ms; (xv) 35-40 ms; (xvi) 40-45 ms; (xvii) 45-50

ms; (xviii) 50-55 ms; (xix) 55-60 ms; (xx) 60-65 ms; (xxi) 65-70 ms; (xxii) 70-75 ms; (xxiii) 75-80 ms; (xxiv) 80-85 ms; (xxv) 85-90 ms; (xxvi) 90-95 ms; (xxvii) 95-100 ms; and (xxviii) > 100 ms.

26. A mass spectrometer as claimed in claim 16, wherein said one or more transient DC voltages create: (i) a potential hill or barrier; (ii) a potential well; (iii) a combination of a potential hill or barrier and a potential well; (iv) multiple potential hills or barriers; (v) multiple potential wells; or (vi) a combination of multiple potential hills or barriers and multiple potential wells.

27. A mass spectrometer as claimed in claim 16, wherein said one or more transient DC voltage waveforms comprise a repeating waveform.

28. A mass spectrometer as claimed in claim 27, wherein said one or more transient DC voltage waveforms comprise a square wave.

29. A mass spectrometer as claimed in claim 16, wherein said one or more transient DC voltage waveforms create a plurality of potential peaks or wells separated by intermediate regions.

30. A mass spectrometer as claimed in claim 29, wherein the DC voltage gradient in said intermediate regions is zero or non-zero.

31. A mass spectrometer as claimed in claim 29, wherein said DC voltage gradient in said intermediate regions is positive or negative.

32. A mass spectrometer as claimed in claim 29, wherein the DC voltage gradient in said intermediate regions is linear.

33. A mass spectrometer as claimed in claim 29, wherein the DC voltage gradient in said intermediate regions is non-linear.

34. A mass spectrometer as claimed in claim 33, wherein said DC voltage gradient in said intermediate regions increases or decreases exponentially.

35. A mass spectrometer as claimed in claim 29, wherein the amplitude of said potential peaks or wells remains substantially constant.

36. A mass spectrometer as claimed in claim 29, wherein the amplitude of said potential peaks or wells becomes progressively larger or smaller.

37. A mass spectrometer as claimed in claim 36, wherein the amplitude of said potential peaks or wells increases or decreases either linearly or non-linearly.

38. A mass spectrometer as claimed in claim 16, wherein in use an axial DC voltage gradient is maintained along at least a portion of the length of said mass filter and wherein said axial voltage gradient varies with time.

39. A mass spectrometer as claimed in claim 16, wherein said mass filter comprises a first electrode held at a first reference potential, a second electrode held at a second reference potential, and a third electrode held at a third reference potential, wherein:

at a first time t_1 a first DC voltage is supplied to said first electrode so that said first electrode is held at a first potential above or below said first reference potential;

at a second later time t_2 a second DC voltage is supplied to said second electrode so that said second electrode is held at a second potential above or below said second reference potential; and

at a third later time t_3 a third DC voltage is supplied to said third electrode so that said third electrode is held at a third potential above or below said third reference potential.

40. A mass spectrometer as claimed in claim 39, wherein:

at said first time t_1 said second electrode is at said second reference potential and said third electrode is at said third reference potential;

at said second time t_2 said first electrode is at said first potential and said third electrode is at said third reference potential; and

at said third time t_3 said first electrode is at said first potential and said second electrode is at said second potential.

41. A mass spectrometer as claimed in claim 39, wherein:

at said first time t_1 said second electrode is at said second reference potential and said third electrode is at said third reference potential;

at said second time t_2 said first electrode is no longer supplied with said first DC voltage so that said first electrode is returned to said first reference potential and said third electrode is at said third reference potential; and

at said third time t_3 said first electrode is at said first reference potential said second electrode is no longer supplied with said second DC voltage so that said second electrode is returned to said second reference potential.

42. A mass spectrometer as claimed in claim 39, wherein said first, second and third reference potentials are substantially the same.

43. A mass spectrometer as claimed in claim 39, wherein said first, second and third DC voltages are substantially the same.

44. A mass spectrometer as claimed in claim 39, wherein said first, second and third potentials are substantially the same.

45. A mass spectrometer as claimed in claim 16, wherein said mass filter comprises 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30 or >30 segments, wherein each segment comprises 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14,

15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30 or >30 electrodes and wherein the electrodes in a segment are maintained at substantially the same DC potential.

46. A mass spectrometer as claimed in claim 45, wherein a plurality of segments are maintained at substantially the same DC potential.

47. A mass spectrometer as claimed in claim 45, wherein each segment is maintained at substantially the same DC potential as the subsequent nth segment wherein n is 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30 or >30.

48. A mass spectrometer as claimed in claim 16, wherein ions are radially confined within said mass filter in a pseudo-potential well and are moved axially by a real potential barrier or well.

49. A mass spectrometer as claimed in claim 16, wherein in use one or more AC or RF voltage waveforms are applied to at least some of said electrodes so that ions are urged along at least a portion of the length of said mass filter.

50. A mass spectrometer as claimed in claim 16, wherein the transit time of ions through said mass filter is selected from the group consisting of: (i) less than or equal to 20 ms; (ii) less than or equal to 10 ms; (iii) less than or equal to 5 ms; (iv) less than or equal to 1 ms; and (v) less than or equal to 0.5 ms.

51. A mass spectrometer as claimed in claim 16, wherein said mass filter is maintained, in use, at a pressure such that substantially no viscous drag is imposed upon ions passing through said mass filter.

52. A mass spectrometer as claimed in claim 16, wherein, in use, the mean free path of ions passing through said mass filter is greater than the length of said mass filter.

53. A mass spectrometer as claimed in claim 16, wherein in use said one or more transient DC voltages or said one or more transient DC voltage waveforms are initially provided at a first axial position and are then subsequently provided at second, then third different axial positions along said mass filter.

54. A mass spectrometer as claimed in claim 16, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms move from one end of said mass filter to another end of said mass filter so that at least some ions are urged along said mass filter.

55. A mass spectrometer as claimed in claim 16, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms have at least 2, 3, 4, 5, 6, 7, 8, 9 or 10 different amplitudes.

56. A mass spectrometer as claimed in claim 16, wherein the amplitude of said one or more transient DC voltages or said one or more transient DC voltage waveforms remains substantially constant with time.

57. A mass spectrometer as claimed in claim 16, wherein the amplitude of said one or more transient DC voltages or said one or more transient DC voltage waveforms varies with time.

58. A mass spectrometer as claimed in claim 57, wherein the amplitude of said one or more transient DC voltages or said one or more transient DC voltage waveforms either: (i) increases with time; (ii) increases then decreases with time; (iii) decreases with time; or (iv) decreases then increases with time.

59. A mass spectrometer as claimed in claim 16, wherein said mass filter comprises an upstream entrance region, a downstream exit region and an intermediate region, wherein:

in said entrance region the amplitude of said one or more transient DC voltages or said one or more transient DC voltage waveforms has a first amplitude;

in said intermediate region the amplitude of said one or more transient DC voltages or said one or more transient DC voltage waveforms has a second amplitude; and

in said exit region the amplitude of said one or more transient DC voltages or said one or more transient DC voltage waveforms has a third amplitude.

60. A mass spectrometer as claimed in claim 59, wherein the entrance and/or exit region comprise a proportion of the total axial length of said mass filter selected from the group consisting of: (i) < 5%; (ii) 5-10%; (iii) 10-15%; (iv) 15-20%; (v) 20-25%; (vi) 25-30%; (vii) 30-35%; (viii) 35-40%; and (ix) 40-45%.

61. A mass spectrometer as claimed in claim 59, wherein said first and/or third amplitudes are substantially zero and said second amplitude is substantially non-zero.

62. A mass spectrometer as claimed in claim 59, wherein said second amplitude is larger than said first amplitude and/or said second amplitude is larger than said third amplitude.

63. A mass spectrometer as claimed in claim 16, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms pass in use along said mass filter with a first velocity.

64. A mass spectrometer as claimed in claim 63, wherein said first velocity: (i) remains substantially constant; (ii) varies; (iii) increases; (iv) increases then decreases; (v) decreases; (vi) decreases then increases; (vii) reduces to substantially zero; (viii) reverses direction; or (ix) reduces to substantially zero and then reverses direction.

65. A mass spectrometer as claimed in claim 63, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms causes some ions within said mass filter to pass along said mass filter with a second different velocity.

66. A mass spectrometer as claimed in claim 63, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms causes at least some

ions within said mass filter to pass along said mass filter with a third different velocity.

67. A mass spectrometer as claimed in claim 63, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms causes at least some ions within said mass filter to pass along said mass filter with a fourth different velocity.

68. A mass spectrometer as claimed in claim 63, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms causes at least some ions within said mass filter to pass along said mass filter with a fifth different velocity.

69. A mass spectrometer as claimed in claim 63, wherein said second and/or said third and/or said fourth and/or said fifth velocity is at least 1, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95 or 100 m/s faster than said first velocity.

70. A mass spectrometer as claimed in claim 63, wherein said second and/or said third and/or said fourth and/or said fifth velocity is at least 1, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95 or 100 m/s slower than said first velocity.

71. A mass spectrometer as claimed in claim 63, wherein said first velocity is selected from the group consisting of: (i) 10-250 m/s; (ii) 250-500 m/s; (iii) 500-750 m/s; (iv) 750-1000 m/s; (v) 1000-1250 m/s; (vi) 1250-1500 m/s; (vii) 1500-1750 m/s; (viii) 1750-2000 m/s; (ix) 2000-2250 m/s; (x) 2250-2500 m/s; (xi) 2500-

2750 m/s; (xii) 2750-3000 m/s; (xiii) 3000-3250 m/s; (xiv) 3250-3500 m/s; (xv) 3500-3750 m/s; (xvi) 3750-4000 m/s; (xvii) 4000-4250 m/s; (xviii) 4250-4500 m/s; (xix) 4500-4750 m/s; (xx) 4750-5000 m/s; (xxi) 5000-5250 m/s; (xxii) 5250-5500 m/s; (xxiii) 5500-5750 m/s; (xxiv) 5750-6000 m/s; and (xxv) > 6000 m/s.

72. A mass spectrometer as claimed in claim 63, wherein said second and/or said third and/or said fourth and/or said fifth velocity are selected from the group consisting of: (i) 10-250 m/s; (ii) 250-500 m/s; (iii) 500-750 m/s; (iv) 750-1000 m/s; (v) 1000-1250 m/s; (vi) 1250-1500 m/s; (vii) 1500-1750 m/s; (viii) 1750-2000 m/s; (ix) 2000-2250 m/s; (x) 2250-2500 m/s; (xi) 2500-2750 m/s; (xii) 2750-3000 m/s; (xiii) 3000-3250 m/s; (xiv) 3250-3500 m/s; (xv) 3500-3750 m/s; (xvi) 3750-4000 m/s; (xvii) 4000-4250 m/s; (xviii) 4250-4500 m/s; (xix) 4500-4750 m/s; (xx) 4750-5000 m/s; (xxi) 5000-5250 m/s; (xxii) 5250-5500 m/s; (xxiii) 5500-5750 m/s; (xxiv) 5750-6000 m/s; and (xxv) > 6000 m/s.

73. A mass spectrometer as claimed in claim 16, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms has a frequency, and wherein said frequency: (i) remains substantially constant; (ii) varies; (iii) increases; (iv) increases then decreases; (v) decreases; or (vi) decreases then increases.

74. A mass spectrometer as claimed in claim 16, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms has a wavelength, and wherein said wavelength: (i) remains substantially

constant; (ii) varies; (iii) increases; (iv) increases then decreases; (v) decreases; or (vi) decreases then increases.

75. A mass spectrometer as claimed in claim 16, wherein two or more transient DC voltages or two or more transient DC voltage waveforms pass simultaneously along said mass filter.

76. A mass spectrometer as claimed in claim 75, wherein said two or more transient DC voltages or said two or more transient DC voltage waveforms are arranged to move: (i) in the same direction; (ii) in opposite directions; (iii) towards each other; or (iv) away from each other.

77. A mass spectrometer as claimed in claim 16, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms passes along said mass filter and at least one substantially stationary transient DC potential voltage or voltage waveform is provided at a position along said mass filter.

78. A mass spectrometer as claimed in claim 16, wherein said one or more transient DC voltages or said one or more transient DC voltage waveforms are repeatedly generated and passed in use along said mass filter, and wherein the frequency of generating said one or more transient DC voltages or said one or more transient DC voltage waveforms: (i) remains substantially constant; (ii) varies; (iii) increases; (iv) increases then decreases; (v) decreases; or (vi) decreases then increases.

79. A mass spectrometer as claimed in claim 16, wherein in use a continuous beam of ions is received at an entrance to said mass filter.

80. A mass spectrometer as claimed in claim 16, wherein in use packets of ions are received at an entrance to said mass filter.

81. A mass spectrometer as claimed in claim 16, wherein in use pulses of ions emerge from an exit of said mass filter.

82. A mass spectrometer as claimed in claim 81, further comprising an ion detector, said ion detector being arranged to be substantially phase locked in use with the pulses of ions emerging from the exit of the mass filter.

83. A mass spectrometer as claimed in claim 81, further comprising a Time of Flight mass analyser comprising an electrode for injecting ions into a drift region, said electrode being arranged to be energised in use in a substantially synchronised manner with the pulses of ions emerging from the exit of the mass filter.

84. A mass spectrometer as claimed in claim 16, wherein said mass filter is selected from the group consisting of: (i) an ion funnel comprising a plurality of electrodes having apertures therein through which ions are transmitted in use, wherein the diameter of said apertures becomes progressively smaller or larger; (ii) an ion tunnel comprising a plurality of electrodes having apertures therein through which ions are

transmitted in use, wherein the diameter of said apertures remains substantially constant; and (iii) a stack of plate, ring or wire loop electrodes.

85. A mass spectrometer as claimed in claim 16, wherein said mass filter comprises a plurality of electrodes, each electrode having an aperture through which ions are transmitted in use.

86. A mass spectrometer as claimed in claim 16, wherein each electrode has a substantially circular aperture.

87. A mass spectrometer as claimed in claim 16, wherein each electrode has a single aperture through which ions are transmitted in use.

88. A mass spectrometer as claimed in claim 85, wherein the diameter of the apertures of at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% or 95% of the electrodes forming said mass filter is selected from the group consisting of: (i) less than or equal to 10 mm; (ii) less than or equal to 9 mm; (iii) less than or equal to 8 mm; (iv) less than or equal to 7 mm; (v) less than or equal to 6 mm; (vi) less than or equal to 5 mm; (vii) less than or equal to 4 mm; (viii) less than or equal to 3 mm; (ix) less than or equal to 2 mm; and (x) less than or equal to 1 mm.

89. A mass spectrometer as claimed in claim 16, wherein at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% or 95% of the electrodes forming the mass filter have apertures which are substantially the same size or area.

90. A mass spectrometer as claimed in claim 16, wherein said mass filter comprises a segmented rod set.

91. A mass spectrometer as claimed in claim 16, wherein said mass filter consists of: (i) 10-20 electrodes; (ii) 20-30 electrodes; (iii) 30-40 electrodes; (iv) 40-50 electrodes; (v) 50-60 electrodes; (vi) 60-70 electrodes; (vii) 70-80 electrodes; (viii) 80-90 electrodes; (ix) 90-100 electrodes; (x) 100-110 electrodes; (xi) 110-120 electrodes; (xii) 120-130 electrodes; (xiii) 130-140 electrodes; (xiv) 140-150 electrodes; (xv) more than 150 electrodes; or (xvi) ≥ 15 electrodes.

92. A mass spectrometer as claimed in claim 16, wherein the thickness of at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% or 95% of said electrodes is selected from the group consisting of: (i) less than or equal to 3 mm; (ii) less than or equal to 2.5 mm; (iii) less than or equal to 2.0 mm; (iv) less than or equal to 1.5 mm; (v) less than or equal to 1.0 mm; and (vi) less than or equal to 0.5 mm.

93. A mass spectrometer as claimed in claim 16, wherein said mass filter has a length selected from the group consisting of: (i) less than 5 cm; (ii) 5-10 cm; (iii) 10-15 cm; (iv) 15-20 cm; (v) 20-25 cm; (vi) 25-30 cm; and (vii) greater than 30 cm.

94. A mass spectrometer as claimed in claim 16, wherein at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, or 95% of said electrodes are connected to both a DC and an AC or RF voltage supply.

95. A mass spectrometer as claimed in claim 16, wherein axially adjacent electrodes are supplied with AC or RF voltages having a phase difference of 180°.

96. A mass spectrometer as claimed in claim 16, further comprising an ion source selected from the group consisting of: (i) Electrospray ("ESI") ion source; (ii) Atmospheric Pressure Chemical Ionisation ("APCI") ion source; (iii) Atmospheric Pressure Photo Ionisation ("APPI") ion source; (iv) Matrix Assisted Laser Desorption Ionisation ("MALDI") ion source; (v) Laser Desorption Ionisation ("LDI") ion source; (vi) Inductively Coupled Plasma ("ICP") ion source; (vii) Electron Impact ("EI) ion source; (viii) Chemical Ionisation ("CI") ion source; (ix) a Fast Atom Bombardment ("FAB") ion source; and (x) a Liquid Secondary Ions Mass Spectrometry ("LSIMS") ion source.

97. A mass spectrometer as claimed in claim 16, further comprising a continuous ion source.

98. A mass spectrometer as claimed in claim 16, further comprising a pulsed ion source.

99. A mass filter for separating ions according to their mass to charge ratio, said mass filter comprising at least seven electrodes wherein, in use, an AC or RF voltage is applied to said electrodes in order to radially confine ions within said mass filter and wherein in use one or more transient DC voltages or one or more transient DC voltage waveforms are progressively applied to said electrodes so that at least some ions having a first mass to charge ratio are separated from

other ions having a second different mass to charge ratio which remain substantially radially confined within said mass filter.

100. A mass filter for separating ions according to their mass to charge ratio, said mass filter comprising at least seven electrodes wherein, in use, an AC or RF voltage is applied to said electrodes in order to radially confine ions within said mass filter and wherein in use one or more transient DC voltages or one or more transient DC voltage waveforms are progressively applied to said electrodes so that ions are moved towards a region of the mass filter wherein at least one electrode has a potential such that at least some ions having a first mass to charge ratio will pass across said potential whereas other ions having a second different mass to charge ratio will not pass across said potential but will remain substantially radially confined within said mass filter.

101. A mass filter for separating ions according to their mass to charge ratio, said mass filter comprising a plurality of electrodes wherein, in use, an AC or RF voltage is applied to said electrodes in order to radially confine ions within said mass filter and wherein in use one or more transient DC voltages or one or more transient DC voltage waveforms are progressively applied to said electrodes so that:

(i) ions are moved towards a region of the mass filter wherein at least one electrode has a first potential such that at least some ions having first and second different mass to charge ratios will pass across said first potential whereas other ions having a third

different mass to charge ratio will not pass across said first potential; and then

(ii) ions having said first and second mass to charge ratios are moved towards a region of the mass filter wherein at least one electrode has a second potential such that at least some ions having said first mass to charge ratio will pass across said second potential whereas other ions having said second different mass to charge ratio will not pass across said second potential.

102. A method of mass spectrometry comprising:

receiving ions in a mass filter comprising at least seven electrodes wherein an AC or RF voltage is applied to said electrodes in order to radially confine ions within said mass filter; and

progressively applying to said electrodes one or more transient DC voltages or one or more transient DC voltage waveforms so that at least some ions having a first mass to charge ratio are separated from other ions having a second different mass to charge ratio which remain substantially radially confined within said mass filter.

103. A method of mass spectrometry comprising:

receiving ions in a mass filter comprising at least seven electrodes wherein an AC or RF voltage is applied to said electrodes in order to radially confine ions within said mass filter; and

progressively applying to said electrodes one or more transient DC voltages or one or more transient DC voltage waveforms so that ions are moved towards a region of the mass filter wherein at least one electrode

has a potential such that at least some ions having a first mass to charge ratio will pass across said potential whereas other ions having a second different mass to charge ratio will not pass across said potential but will remain substantially radially confined within said mass filter.

104. A method of mass spectrometry comprising:

receiving ions in a mass filter comprising a plurality of electrodes wherein an AC or RF voltage is applied to said electrodes in order to radially confine ions within said mass filter;

progressively applying to said electrodes one or more transient DC voltages or one or more transient DC voltage waveforms so that ions are moved towards a region of the mass filter wherein at least one electrode has a first potential such that at least some ions having a first and second different mass to charge ratios will pass across said first potential whereas other ions having a third different mass to charge ratio will not pass across said first potential; and then

progressively applying to said electrodes one or more transient DC voltages or one or more transient DC voltage waveforms so that ions having said first and second mass to charge ratios are moved towards a region of the mass filter wherein at least one electrode has a second potential such that at least some ions having said first mass to charge ratio will pass across said second potential whereas other ions having said second different mass to charge ratio will not pass across said second potential.

105. A method of mass to charge ratio separation comprising:

receiving ions in a mass filter comprising at least seven electrodes wherein an AC or RF voltage is applied to said electrodes in order to radially confine ions within said mass filter; and

progressively applying to said electrodes one or more transient DC voltages or one or more transient DC voltage waveforms so that at least some ions having a first mass to charge ratio are separated from other ions having a second different mass to charge ratio which remain substantially radially confined within said mass filter.

106. A method of mass to charge ratio separation comprising:

receiving ions in a mass filter comprising at least seven electrodes wherein an AC or RF voltage is applied to said electrodes in order to radially confine ions within said mass filter; and

progressively applying to said electrodes one or more transient DC voltages or one or more transient DC voltage waveforms so that ions are moved towards a region of the mass filter wherein at least one electrode has a potential such that at least some ions having a first mass to charge ratio will pass across said potential whereas other ions having a second different mass to charge ratio will not pass across said potential but will remain substantially radially confined within said mass filter.

107. A method of mass to charge ratio separation comprising:

receiving ions in a mass filter comprising a plurality of electrodes wherein an AC or RF voltage is applied to said electrodes in order to radially confine ions within said mass filter;

progressively applying to said electrodes one or more transient DC voltages or one or more transient DC voltage waveforms so that ions are moved towards a region of the mass filter wherein at least one electrode has a first potential such that at least some ions having a first and second different mass to charge ratios will pass across said first potential whereas other ions having a third different mass to charge ratio will not pass across said first potential; and then

progressively applying to said electrodes one or more transient DC voltages or one or more transient DC voltage waveforms so that ions having said first and second mass to charge ratios are moved towards a region of the mass filter wherein at least one electrode has a second potential such that at least some ions having said first mass to charge ratio will pass across said second potential whereas other ions having said second different mass to charge ratio will not pass across said second potential.

108. A mass filter wherein ions separate within said mass filter according to their mass to charge ratio and assume different essentially static or equilibrium axial positions along the length of said mass filter.

109. A mass filter as claimed in claim 108, wherein said mass filter comprises a plurality of electrodes wherein, in use, an AC or RF voltage is applied to said electrodes in order to radially confine ions within said mass filter.

110. A mass filter as claimed in claim 109, wherein one or more transient DC voltages or one or more transient DC voltage waveforms are progressively applied to said electrodes so as to urge at least some ions in a first direction.

111. A mass filter as claimed in claim 110, wherein a DC voltage gradient acts to urge at least some ions in a second direction, said second direction being opposed to said first direction.

112. A mass filter as claimed in claim 110, wherein the peak amplitude of said one or more transient DC voltages or said one or more transient DC voltage waveforms remains substantially constant or reduces along the length of the mass filter.

113. A mass filter as claimed in claim 111, wherein said DC voltage gradient progressively increases along the length of the mass filter.

114. A mass filter as claimed in claim 108, wherein once ions have assumed essentially static or equilibrium axial positions along the length of said mass filter at least some of said ions are then arranged to be moved towards an exit of said mass filter.

115. A mass filter as claimed in claim 114, wherein at least some of said ions are arranged to be moved towards an exit of said mass filter by: (i) reducing or increasing an axial DC voltage gradient; (ii) reducing or increasing the peak amplitude of one or more transient DC voltages or one or more transient DC voltage waveforms; (iii) reducing or increasing the velocity of one or more transient DC voltages or one or more transient DC voltage waveforms; or (iv) reducing or increasing the pressure within said mass filter.

116. A mass spectrometer comprising a mass filter as claimed in claim 108.

117. A method of mass to charge ratio separation comprising causing ions to separate within a mass filter and assume different essentially static or equilibrium axial positions along the length of the mass filter.

118. A method of mass to charge ratio separation as claimed in claim 117, wherein said mass filter comprises a plurality of electrodes wherein, in use, an AC or RF voltage is applied to said electrodes in order to radially confine ions within said mass filter.

119. A method of mass to charge ratio separation as claimed in claim 118, wherein one or more transient DC voltages or one or more transient DC voltage waveforms are progressively applied to said electrodes so as to urge at least some ions in a first direction.

120. A method of mass to charge ratio separation as claimed in claim 119, wherein a DC voltage gradient acts to urge at least some ions in a second direction, said second direction being opposed to said first direction.

121. A method of mass to charge ratio separation as claimed in claim 119, wherein the peak amplitude of said one or more transient DC voltages or said one or more transient DC voltage waveforms remains substantially constant or reduces along the length of the mass filter.

122. A method of mass to charge ratio separation as claimed in claim 120, wherein said DC voltage gradient progressively increases along the length of the mass filter.

123. A method of mass to charge ratio separation as claimed in claim 117, wherein once ions have assumed essentially static or equilibrium axial positions along the length of said mass filter at least some of said ions are then arranged to be moved towards an exit of said mass filter.

124. A method of mass to charge ratio separation as claimed in claim 123, wherein at least some of said ions are arranged to be moved towards an exit of said mass filter by: (i) reducing or increasing an axial DC voltage gradient; (ii) reducing or increasing the peak amplitude of one or more transient DC voltages or one or more transient DC voltage waveforms; (iii) reducing or increasing the velocity of one or more transient DC voltages or one or more transient DC voltage waveforms;

or (iv) reducing or increasing the pressure within said mass filter.

125. A method of mass spectrometry comprising the method of mass to charge ratio separation as claimed in claim 117.